

It is a humbling experience to see a live view of the field from a UAV.

/AFS

Unlimited Aerial Visions at Webster Field

Its out in the middle of a corn field, not far south from the first state capitol of Maryland; you wouldn't even know it is there until the front gate suddenly appears to what is obviously, a government facility. This place is called Webster Field and it is both the home of VC-6's aerial operations (the unit itself is headquartered in Norfolk), the Navy's primary fleet UAV operator, and the site of an annual demonstration of the expanding capabilities of unmanned aerial vehicles or UAV's. UAV

development is one of the primary tools in Defense Secretary D. Rumsfeld's "transformation" of the Defense Department and it is appropriate and timely to take a closer look at the UAV's that were on display there on July 14, 2003.

The use for these computerized and unmanned flying machines has always centered on what the military calls ISR, Intelligence, Surveillance and Reconnaissance. Virtually all UAV's, including Global Hawk and Predator are essentially

"sensor dwell" platforms of different endurance and ceiling restrictions.

The sensors that the UAV's carry interestingly do not vary that much, they all contain EO (electrical Optical), FLIRs, while GPS typically controls their location.

UAV's can be classified by their size. Generally too there is a relationship between size and capability and endurance; that is, the largest UAV's have the most capability and endurance. As the size of



When this Global Hawk was deployed in support of operations over Afghanistan it carried the tail code BB but has now been restyled an ED aircraft albeit still adorned with the mission markings earned aft of the "cockpit(i.e. satellite dish) area".

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Hunter is widely used by the Army and is considered to be a considerable first generation success.

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UAV's decreases, their capability also decreases both in terms of the transmission and collection of data and in range or endurance. Two areas where UAV's differ from each other is in their ability to transmit data to satellites (as opposed to line of sight transmission) and in their power source. Not all UAV's are powered by conventional engines, a number of the smaller more tactical battlefield types are actually powered by batteries. Some can also be launched by hand and some require either a runway or a launching rail. In any case, as UAV's get smaller the tradeoffs between range and payload become more apparent than with the larger systems like Global Hawk.

Other military uses for UAV's center around their use for combat operations (UCAV—Unmanned Combat Aerial Vehicle)—sometimes also called UCAS with the "S" standing for System which means that there is more of a support tail for the vehicle. The term UCAS-N denotes the naval use of the unmanned system. Not only are some UAV's configured as UCAV's but some UAV's can carry significant munitions as well. The arming of Predator with Hellfires is well known, lesser known armed UAV's include Hunter which carries a weapon called the "Viper". Hunter's have flown over 9000 flight hours in support of Iraqi Freedom although Viper is not believed to have been used operationally, yet.

Viper is a version of the "BAT" which is essentially a laser guided "glide bomb" that flies around the battlefield for several hours waiting for some tank crew to start their engine upon which Viper's sensors pick up the emissions and directs itself to the source of the heat and thus attacks that hapless tank or heat emitting vehicle. These kinds of munitions are sometimes also referred to as "persistence" munitions. Weapons of this kind are also intended to be used for precise attacks requiring steep angles of attack in either mountains or urban environments. Viper requires a "man in the loop" to lase the target.

Another more predictable development has been the arrival of a number of UCAR's or Unmanned Combat Armed Rotorcraft. The Navy's Firescout, RQ-8A is the best known of these currently, but there are a number of other, much smaller, types that clearly are aimed at a variety of military applications in addition to their use (sans armament) in the civilian or police sectors.

Yamaha in particular has an attractive example that is not much bigger than a lawnmower and quite stylishly finished—not unlike one of their motorcycles. Called the RMAX, Yamaha's unmanned helicopter can stay aloft for 2-3 hours and has a cruise speed of 72 km/hr. It is 143 inches in length, and 48 inches in height. The engine is a two stroke, water cooled engine with 246 cc of displacement and an output of 12ps. The whole beast weighs but 209 pounds and can carry a 22 pound payload which consists of a daylight color camera (680,000 pixels 25 power zoom lens); an infrared camera, a laser distance meter and SD card recording system. The whole payload is stabilized by a 2 axis gyro stabilization with a 2 axis moving pan and tilt control. Yamaha advertises the use of the RMAX for agricultural spraying, plant growth survey and nuclear radiation monitoring.

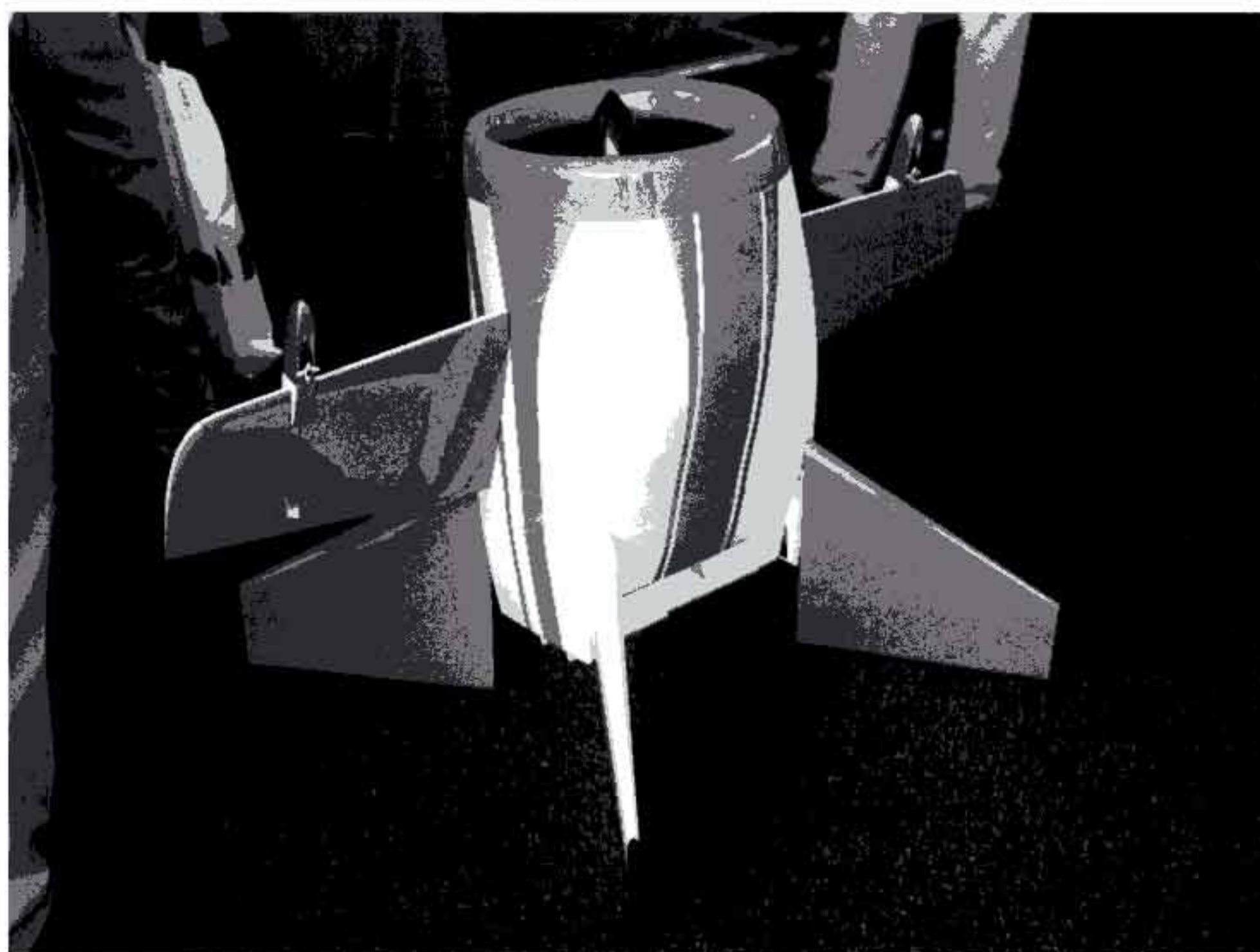
Another related UAV is Schiebel's (Austria) Camcopter and is clearly aimed at the ISR market. It is about the same size and power plant generally as the RMAX but can stay aloft for six hours. Under standard flight conditions the Camcopter has a mission radius of 10 km but that can be extended to 100 km. It has various links; a C band up and down data link is provided and like most UAV's, Camcopter makes extensive use of GPS for navigation. It weighs half as much as the RMAX (95 pounds) but can carry a

55 pound payload. The standard sensor, however, is apparently limited to a forward looking CCD camera. The principal tradeoff between the Camcopter and the RMAX is endurance for capability; the lesser of the two in endurance, the RMAX, can however carry much more of a payload.

Boeing displayed the exotic X-50A CRW at Webster Field. This machine is a canard rotor/wing (CRW) which offers a vertical take-off/landing capability combined with the high subsonic cruise speed of a fixed wing aircraft. Known as the Dragonfly, X-50 is a DARPA project that can fly close to 500 knots. Its real contribution however is that it has an advanced rotor system in that the rotor becomes a wing for both rotary and fixed wing flight. Powered by a conventional turbofan there are diverter valves that direct the thrust to the rotor blade tips or towards the aft where a jet nozzle is used for fixed wing cruise. It is said to have both a manned and an unmanned potential.

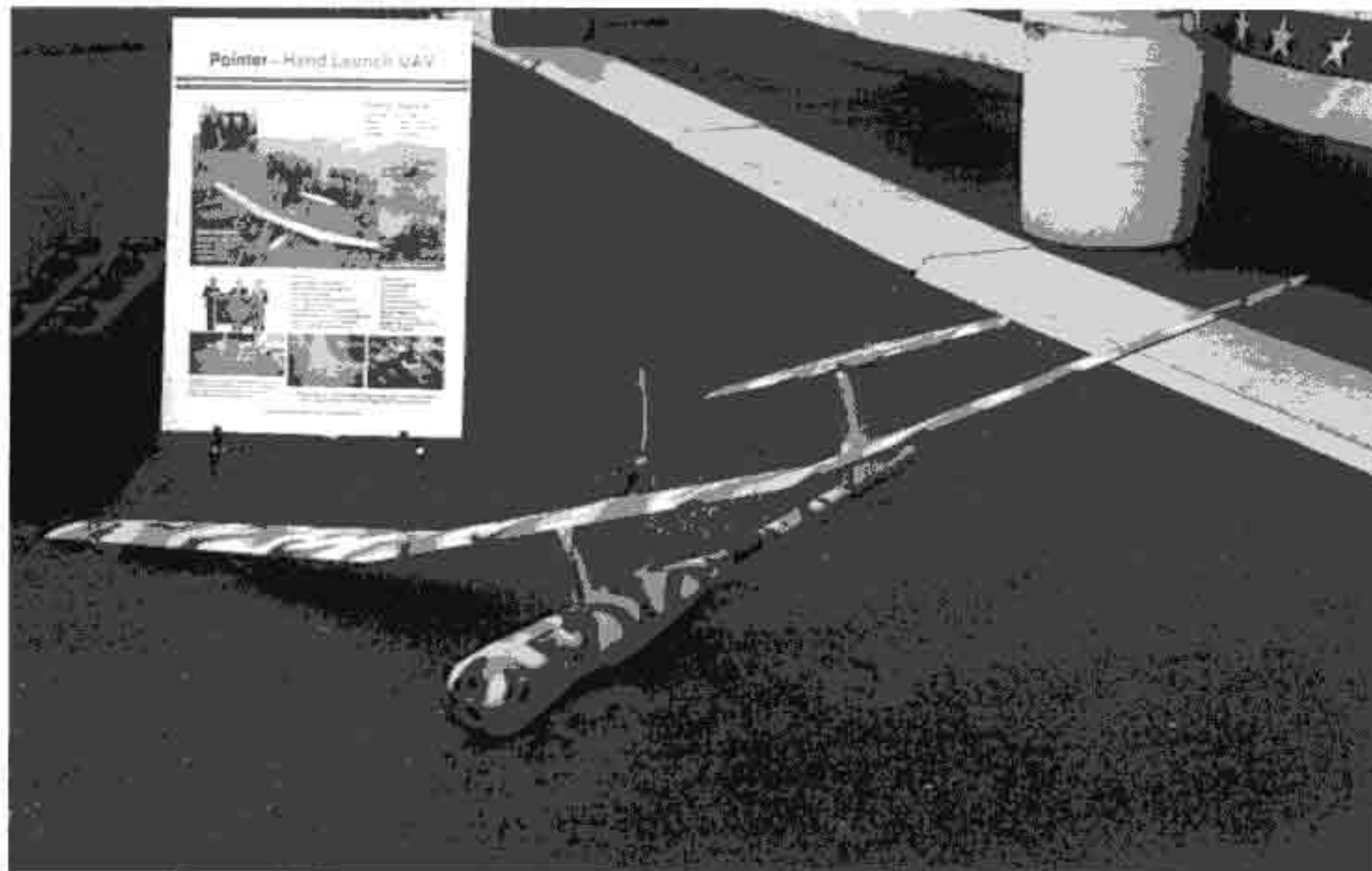
One of the more interesting unmanned aerial vehicles is the application of Tiltrotor technology in the Bell "Eagle Eye". These tiltrotor UAV's are called VUAV or vertical take off-and-landing unmanned aerial vehicles. They will form a central tool in the Coast Guard's Deepwater program of providing ISR capability for a new class

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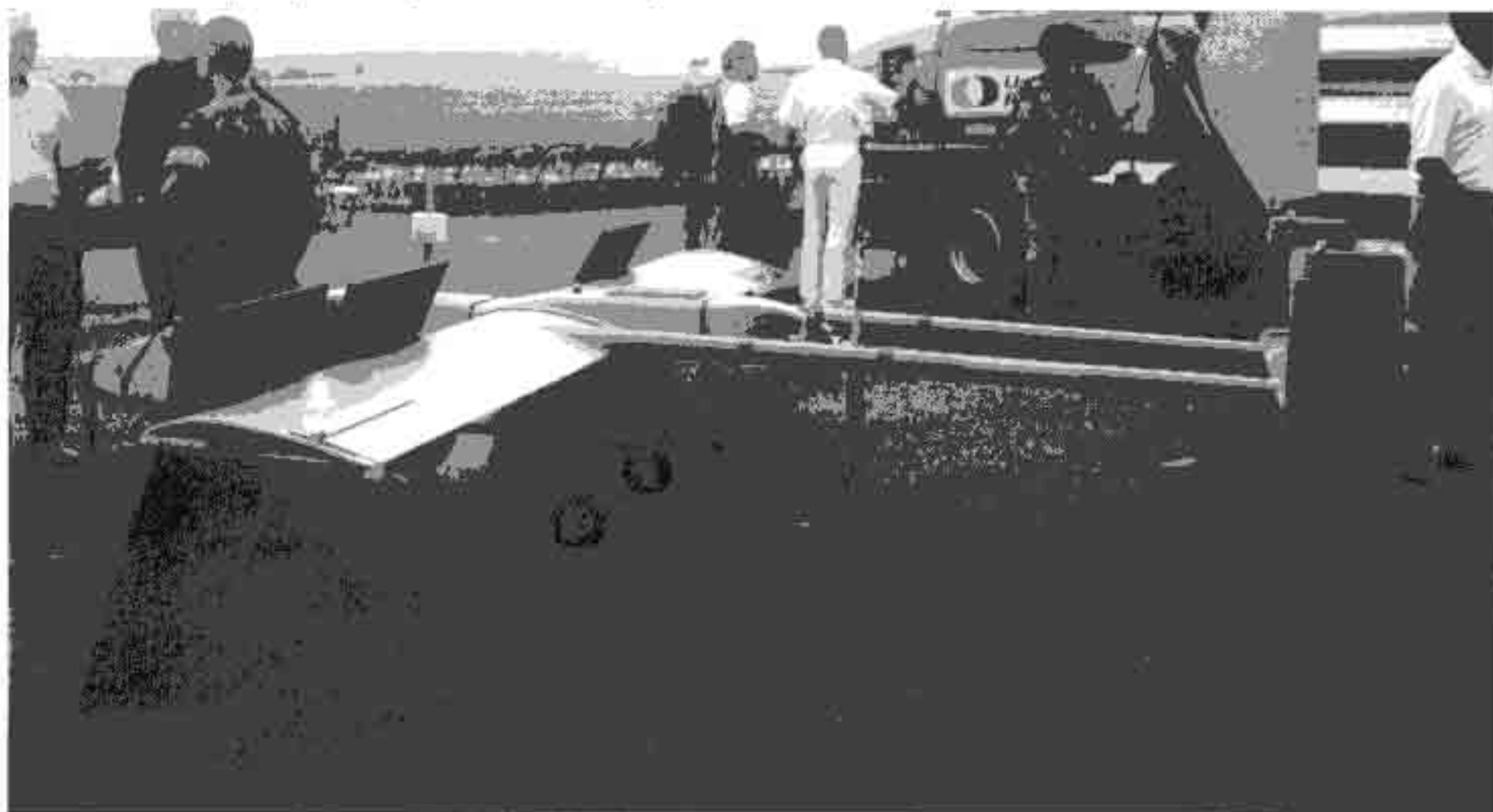


Aurora's Golden Eye 50 made its first flight in September of 2003 and is being touted for its ability to operate in narrow and vertical places for chemical, biological and nuclear weapons detection—it is also capable of level flight!

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Pointer (FQM 151A) is one of a new crop of hand launched, battery powered UAV's that may have more battlefield application than that first thought given the use of Improvised Explosive Devices (IED) in Iraq. Both the Army and the USMC operate Pointers. /AFS



Like Hunter, Shadow has been battle tested since the first Iraq war. /AFS



Dragon Eye is operational with the USMC (933 units) and the Navy is also looking at it; it is equipped with an autopilot for autonomous flight operation and has a 30-60 minute endurance with 35 kt airspeed. Like Pointer it is both battery powered and hand (or bungee cord) launched. Like Pointer it "lands" by crashing into the ground when the engines simply stop running at 20 feet or so. /AFS

of ocean going cutter. Although the contract to build Eagle Eye has been awarded (February 2003) none has flown as of this writing and none were at Webster Field. They will become quite common one suspects.

It might be helpful to establish the categories of current UAV's. Currently there are:

1. High Altitude, High Endurance. Currently there is only one UAV in this category: Global Hawk. Used essentially for strategic and tactical intelligence by the theater commander where "sensor dwell" is useful. Global Hawk was present at Webster only in model form.

2. Mid altitude, 4-8 hour endurance. Dominated within the military by the Predator, this category also includes Hunter, and Pioneer. Predator, however, has an endurance of almost 24 hours unlike Hunter, Pioneer and Shadow all of which are about 6-8 hours (and a ceiling of 15,000—Predator can go to 45,000 feet, Global Hawk to 60,000+ feet). It is this category that has seen considerable attention paid to armament with "persistence" munitions.

3. Low altitude, less than 4 hour endurance. Used within the military by combat formations as small as the platoon, these UAV's dominated the Webster Field demonstration and also have considerable civilian application as well. They may be increasingly found providing surveillance of site specific targets such as (nuclear)power plants or water sources.

4. VUAV's include helicopter and tiltrotor designs and will be used increasingly by the military for surveillance in maritime applications. Firescout and Eagle Eye will dominate this category. Firescout in particular, will be armed.

5. UCAV. Much has been written about using unmanned combat air vehicles to attack highly defended targets and may well form a means of both carrier air wing and non aircraft carrier deployment of attack aircraft in the future. This category of UAV's also dominates the use of stealth within the overall family of UAVs.

6. There is a final category of UAV's and that is the so-called micro UAV's. Advertised as being the size of one's hands these small air vehicles might be useful in some kinds of urban environments but the technology to allow a small device to stay in the air noiselessly for any useful length of time remains a tech-

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nological hurdle.

The table on page 7 is an attempt to categorize UAV's.

An interesting sidebar to these categories is that the major aerospace companies are heavily involved in the High Altitude, High Endurance, UCAV and VUAV areas but a multitude of companies, many with no prior government contracting experience and not even aerospace experience are becoming involved with the low altitude, under 4 hour endurance category (#3) and micro UAV's (#6). Worldwide there is a baffling number of companies and products of these low altitude UAV's with probably increasingly intensive competition in this area.

Although not on display at Webster but deserving of passing mention are the Navy's underwater unmanned vehicles and the Army's Future Combat System both of which will include some form of robotic and unmanned "highly dangerous" mission orientation.

Between 2002 and 2005, DOD plans to spend some \$5.24 Billion on UAV's, of which \$1.845 Billion will be for procurement and \$3.396 Billion will be on Research, Development, Test and Evaluation (RDT&E). Global Hawk remains the dominant player in DOD funding and in what the military calls "concept of operations" discussions. Interestingly, the Air Force recently announced (Dec 03) that Global Hawk would no longer be flown as a true UAV, instead the Air Force intends now to always have a "man in the loop" and Global Hawk will become thus a large RPV!

Mention was made in issue 14 of the Coast Guard's interest in Global Hawk and indeed \$224 million will be provided in FY 05 for this mission. Somewhat less than half of the procurement funds (\$884 million out of the \$1.845 Billion) will go for



Boeing's X-50 Dragonfly offers helicopter performance combined with jet speed that could have substantial military appeal. /AFS

Global Hawk and which sum will provide the procurement of 14 machines. An additional \$1.195 Billion will be spent on RDT&E for Global Hawk.

Clearly the last chapter hasn't been written Global Hawk but Predator may be nearing the end of its development. Predator will still take up about a third of the procurement total with some \$612.8 million buying at least 79 more Predators. But Predator's RDT&E share is only \$99 million which indicates that its development is coming to an end. The primary new army procurement UAV remains the Shadow with \$286 million in procurement funds and \$83 million additional for RDT&E.

Currently none of the UCAV's is slated for actual procurement but RDT&E funds for them are substantial. The Air Force, and not the Navy, seems to have taken the lead in research funding for the UCAV for FY 02-05. In this period, the Air Force

will spend three times the Navy amount (\$686 million vis \$229 million) while DARPA, the agency most responsible for the development of UAV's in the military generally, is reducing its role (as the Air Force increases theirs) spending only \$125 million in FY 02-03 and \$50 million in FY 04 and 05. Interestingly, over this same period, however, the navy's interest in

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One of the few "real" aircraft at Webster was this Gulfstream V still in primer paint flown up specially for the event. Gulfstream marketed it as a UAV air refueler. N916GA/AFS



Boeing's ScanEagle is launched off a rail and recovered by a pole. It is aimed at the maritime market. /AFS

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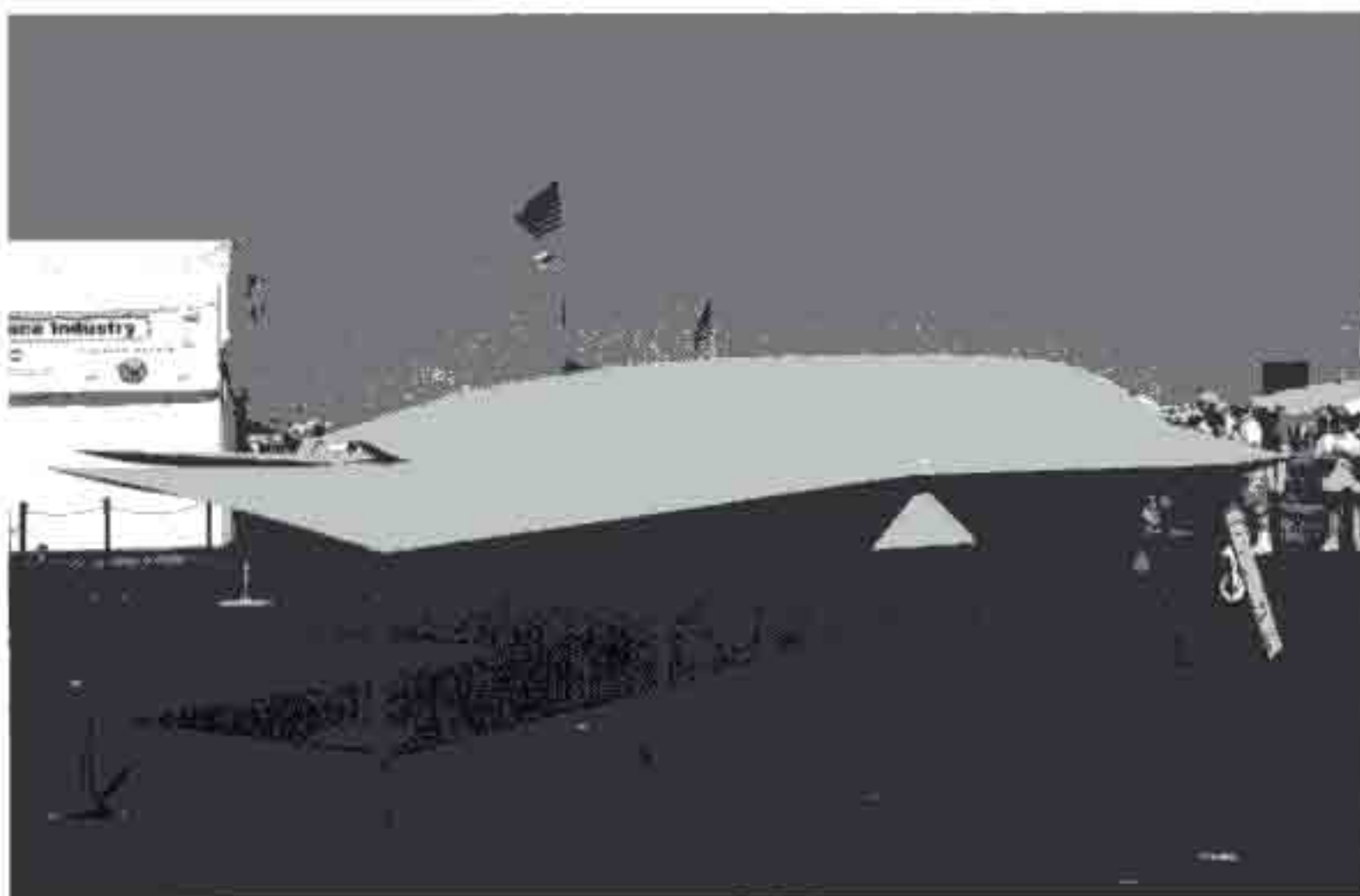
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Another of Aurora's products, this stealth looking UAV has already flown and is intended to be co-marketed by Raytheon as a UCAV. /AFS



A mockup of the X-45 made an appearance at the Dayton Airshow in 2003. 00-6345/AFS



One of the few really good reasons to go to huge airshows like MCAS Miramar's is the presence of aircraft rarely seen elsewhere; this MQ-1A Predator is armed with two Hellfire missiles. It can be safely assumed that UAV's will increasingly be armed. 0-0068/AFS

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underwater unmanned vehicles is going to spend \$267 million for FY 02-05. Air Force dominance of test funds does not necessarily, of course, indicate dominance of procurement but both services are quite interested in the whole notion of unmanned combat applications.

Without much public notice, the Air Force has, in recent days, made major changes in the CONOPS or Concept of Operations for its UAV's.

The Air Force now flies both Global Hawk and Predator with "pilots in control". This change essentially makes these UAV's back into RPV's and reflects the time sensitive nature of Air Force UAV/RPV operations. Nonetheless, it seems a waste of funds to have spent all that money for computer control and then revert to manned control.

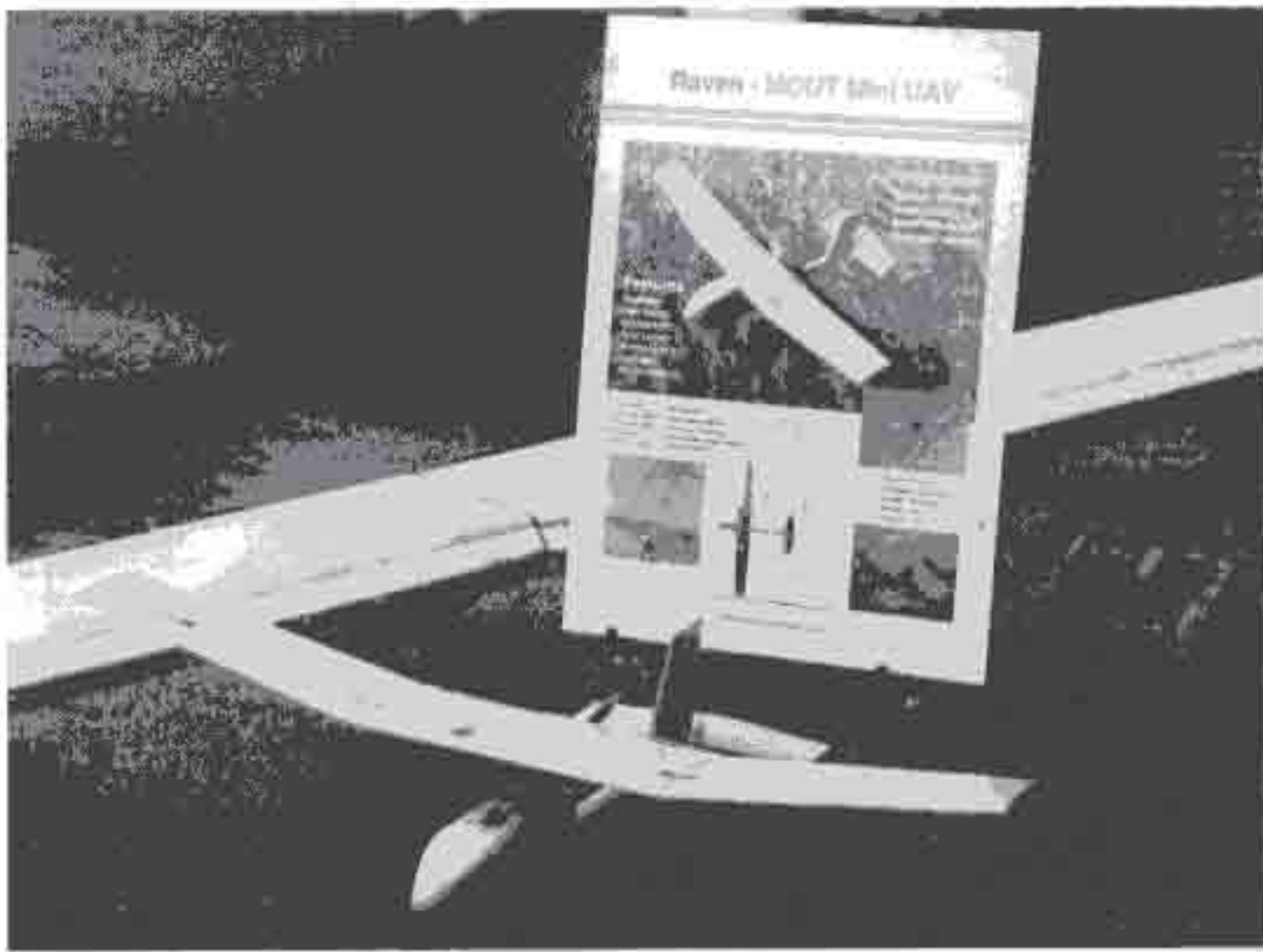
There are many other problems with UAV's, for example: How such machines will tell the difference between friend and foe is just one of their giant limitations but there is no doubt that certain applications will be well served by these beasts. Another problem is that it takes a goodly number of highly trained technical staff to support just one UAV and most UAV's are not allowed to fly in anything other than restricted airspace because a UAV has no idea when some other aircraft (or SAM) is nearby. Global Hawk was just recently, however, granted permission to fly through controlled airspace but as it flies at 60,000 plus feet it has no real potential for disaster. In any case, it is instructive to note in this regard that while UAV's have had much of world's attention since the Gulf War in 1991 and again after Kosovo in 1995 and Iraqi Freedom in 2003, RPV's, or remotely piloted vehicles which have a "man in the loop" have not gone away. Barely noticed was the fact that the navy deployed a DC-130 to Iraqi Freedom where it did indeed launch repeated missions with an RPV (Firebee). It too is a proven, and cheaper, technology.

Finally, caution should be the word in discussing all but the intelligence gathering function of UAV's which has been proven beyond any reasonable doubt. Further research may well further validate the use of UAV's in a widely increasing scope of operations but there is a considerable difference between establishing a technological capability to do something and realizing an operational utility and advantage to do the same thing. Mine and land mine detection, chemical, biological and radioactive detection and classification remain very promising venues for both aerial and ground robotics. But make no mistake, these are "robots". Machines are not going to take over every aspect of military operations but they will remain useful adjuncts to "boots on the ground" or Jedi Knights in the cockpits. As was mentioned above, it is telling that the Air Force now insists of keeping a man in the loop of control and decision making for Global Hawk.

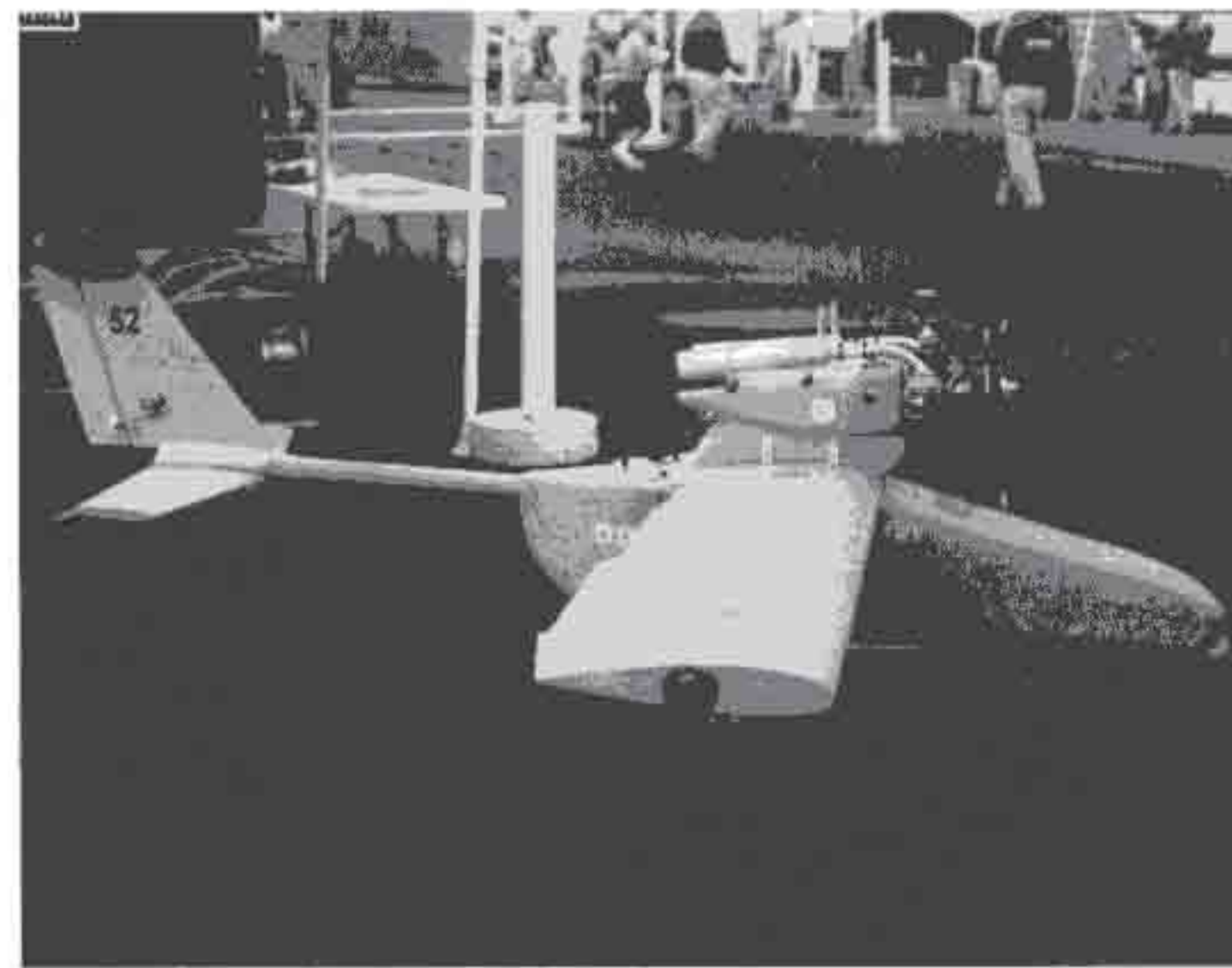
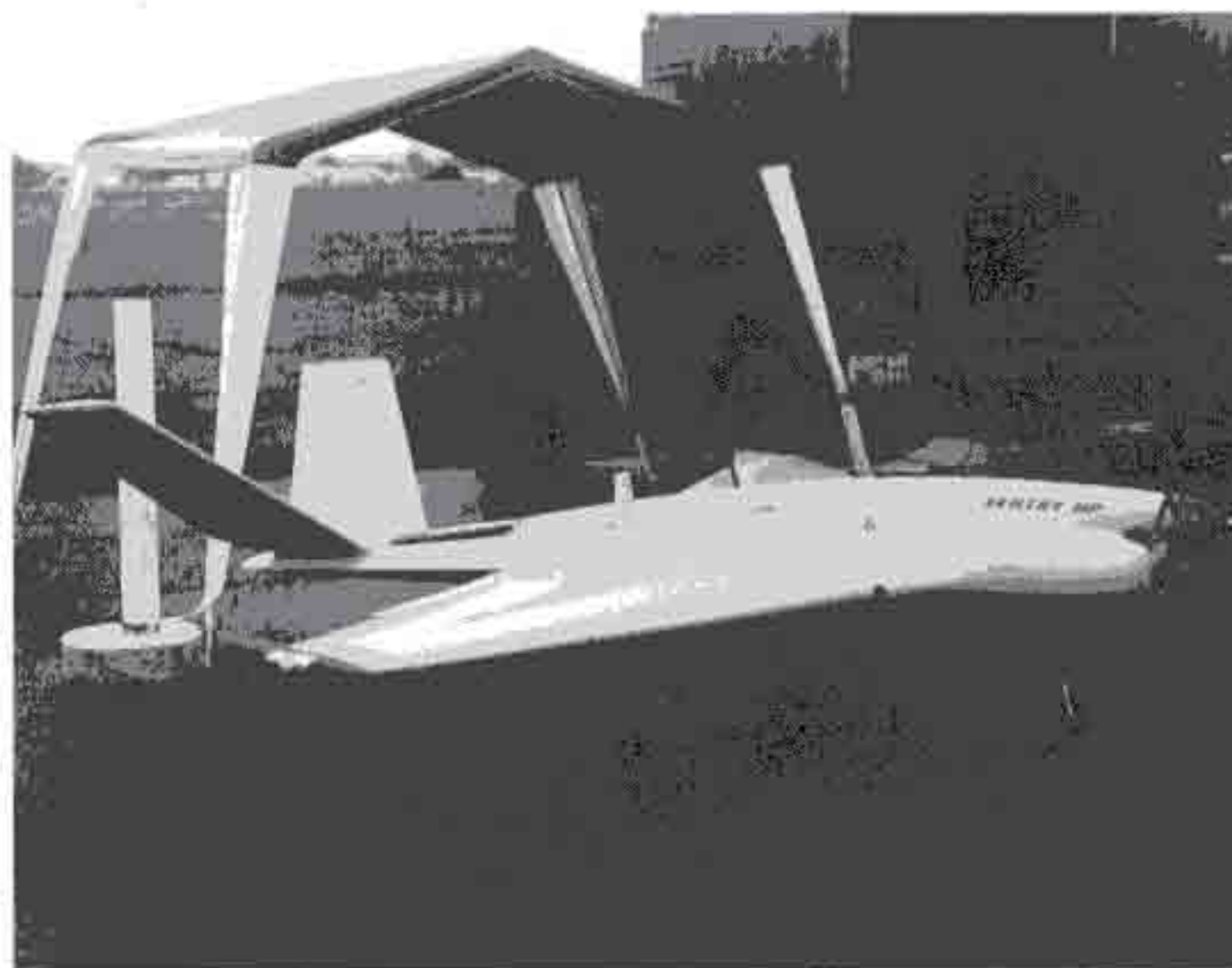


Viper is a "persistence" munition and is close to being fielded.

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The UAV's on this page all illustrate three aspects of UAV design: many are small; some UAV's are battery powered and others are conventionally powered; and they are mostly unappealing aesthetically! /all AFS.



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